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SATELLITE GEOLOGICAL AND GEOPHYSICAL REMOTE SENSING OF ICELAND

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Námafjall Geothermal Area, Iceland:  
Preliminary Analysis of ERTS-1 Image #1229-12142  
ERTS-1 Experiment #9651 - Satellite Geological  
and Geophysical Remote Sensing of Iceland

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One of the objectives of the ERTS-1 experiment in Iceland was to determine the minimum size (and heat flow) of a geothermal area which can be delineated from analysis of MSS imagery of the 13 high-temperature geothermal areas in Iceland (Williams, 1972). It was anticipated that if delineation of several Icelandic geothermal areas by the snow-melt pattern method were to be achieved, a more accurate estimate of heat flow from poorly known geothermal areas (within Iceland and for other areas in the world) can be made by comparison with snow-melt patterns of well-known geothermal areas.

On 9 March 1973 the first suitable ERTS-1, MSS image of Iceland was acquired (1229-12142) in which this hypothesis could be tested. The image of north-central Iceland included 5 of the 13 high-temperature geothermal areas: Peistareykir, Krafla, Námafjall, Askja, and Kverkfjöll (See figure attached to 1:500,000-scale enlargement of ERTS-1 image). Except for Askja all of these areas were cloud free; however part of the Peistareykir, Askja, and Kverkfjöll geothermal areas were in shadow. The Krafla geothermal areas were too small to be discerned (0.5km<sup>2</sup>). Only the Námafjall area was cloud free and not obscured by shadow. Table 1 gives the area and heat flow of these geothermal areas:

Table 1. - Size and Heat Flow of Selected Icelandic Geothermal Areas (From Table 4 in Böðvarsson, 1960, p. 49)

<u>NAME OF GEOTHERMAL AREA</u>	<u>AREA (KM<sup>2</sup>)</u>	<u>HEAT OUTPUT</u>
Peistareykir	2.5	5-25x10 <sup>6</sup> cal/sec
Krafla	0.5	5-25x10 <sup>6</sup> cal/sec
Námafjall	2.5	25-125x10 <sup>6</sup> cal/sec
Askja	?	5-25x10 <sup>6</sup> cal/sec
Kverkfjöll	10	25-125x10 <sup>6</sup> cal/sec

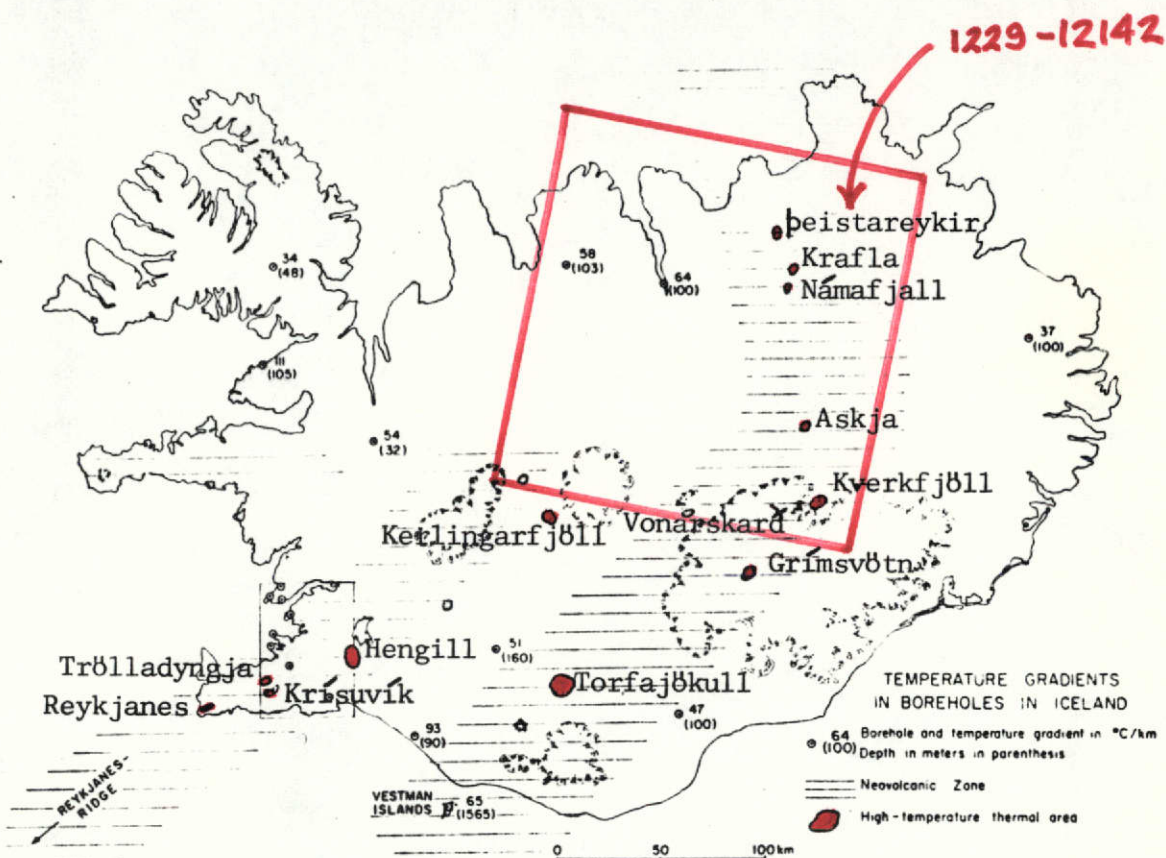
The Námafjall geothermal areas appear as a light grey (or black, depending on MSS band), linear, "ragged" area surrounded by bright white snow, similar to its appearance on aerial thermography (Chaturvedi and Pálmason, 1967). Under optimum conditions the ground resolution capability of the ERTS-1, MSS sensor can distinguish a small geothermal area (2.5km<sup>2</sup>) with a heat output of 25-125x10<sup>6</sup> cal/sec by its snow-melt pattern.

Part of the Þeistarekyrir geothermal area can possibly be seen, but is mostly in shadow. Krafla apparently cannot be discerned, probably because it is too small (both size and heat output). The geothermal areas at Askja (in SE and E part of caldera) are in shadow, but a possible snow-melt pattern or lack of ice on the shore of the lake may be present. Most of the Kverkfjöll geothermal area is in shadow but two features: a partially frozen lake (thermal springs discharging into it) and an (ice) cauldron subsidence feature in the ice cap, the result of subglacial geothermal activity can be clearly seen.

A most interesting aspect of this ERTS-1 image is the open water on the eastern shore of lake Mývatn which is due to thermal spring activity near Vogar (Rist, 1959, p. 121-127; Barth, 1950, p. 18). The other open water areas are due to the high volume of spring discharge (near Kálfaströnd) or at the main river outlet of the lake (Alabrot). A complex pattern of open water occurs at lake Gränavatn, just to the south of Mývatn. In the search for geothermal areas, when one considers that the surface expression of such areas is rather small from a satellite's viewpoint, it should not be overlooked that the "size" of a thermally active area can be markedly increased if the discharge of hot groundwater enters a lake. This is especially important when searching for geothermal areas on satellite thermography or looking at satellite imagery of snow-covered terrain or frozen lakes such as the ERTS-1 image of Mývatn. Even though the Námafjall geothermal area can be discerned on the ERTS-1 image, the open water areas on a "frozen" lake stand out sharply.

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Frontispiece Index Map of the 13 high-temperature geothermal areas in Iceland. (From Fig. 1 of Pálmason, 1967, p. 113)

<u>High-Temperature Geothermal Area</u>	<u>Area (km<sup>2</sup>)</u>	<u>North Latitude</u>	<u>West Longitude</u>
Reykjanes	1	63°49'	22°41'
Trölladyngja	5	63°57'	22°05'
Krísuvík	10	63°54'	22°03'
Hengill	50	64°05'	21°22'
Kerlingarfjöll	5	64°37'	19°16'
Torfajökull	100	63°55'	19°10'
Vonarskard	?	64°41'	17°52'
Grímsvötn	12	64°26'	17°20'
Kverkfjöll	10	64°40'	16°42'
Askja	5	65°02'	16°45'
Námafjall	2.5	65°39'	16°49'
Krafla	0.5	65°42'	16°47'
Theistareykir	2.5	65°52'	17°00'